Proposals

- Generally good
  - Many interesting topics!
  - Some more developed than others
  - Consider trading papers w/a friend in the class for peer editing
- Not quite finished grading (more done than not)
- Some seem to be missing
  - OK to turn in paper 1 (intro/lit review) with paper 2 (design/methods) on Thursday
  - Will lose some points on paper 1
- Will be in my office (CSB 161) Wednesday from 11am-Noon
  - Could arrange to be there earlier if requested

Common Sense

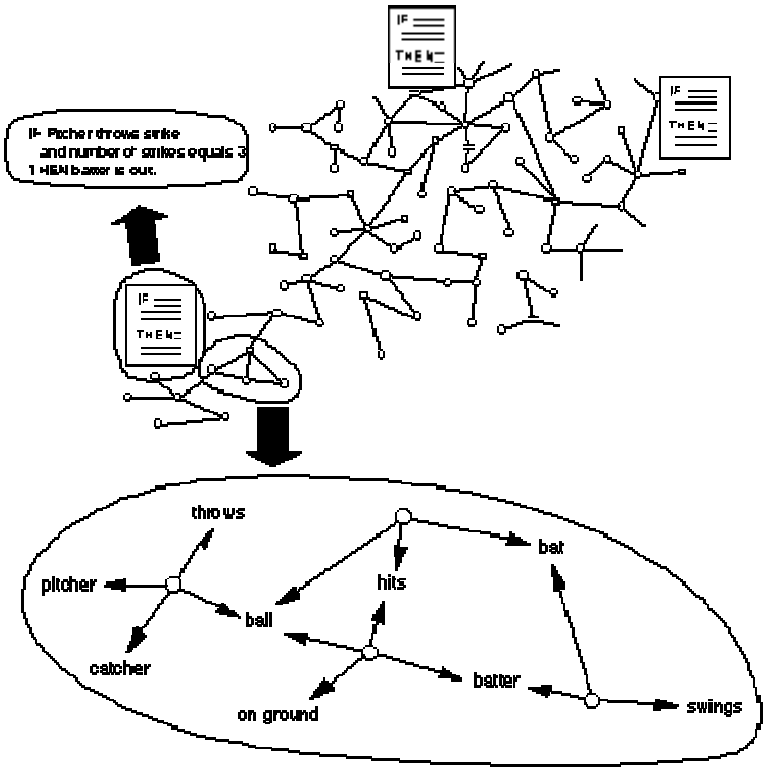
Common vs. Multiple Semantic Systems

- ERPs to words vs. pictures
- ERPs to concrete vs. abstract words

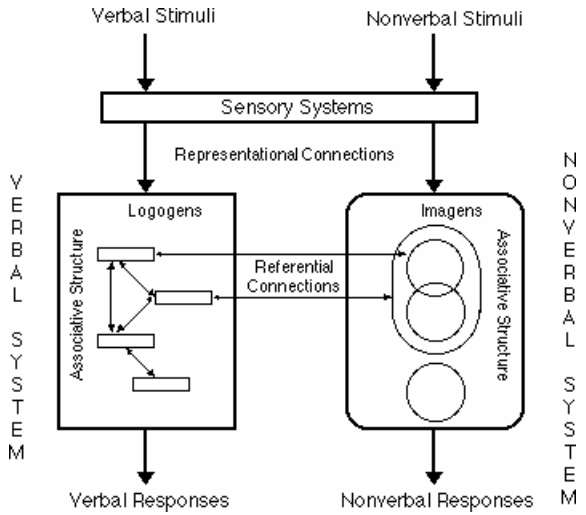
Semantic Systems

- Is there a unitary semantic system where information from all of the different sensory systems is brought together?
- Are there multiple semantic systems for representing information in the brain?

UNITARY



MULTIPLE



Methods

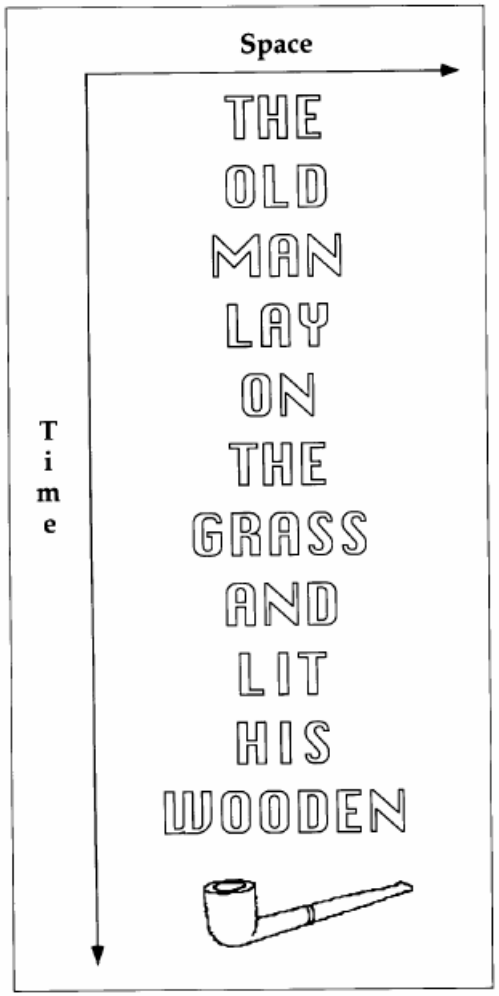


Figure 1. One of the sentences used in the experiment. This is the actual font employed (Chicago). The relative size of the words and the picture is very close to reality.

- Ganis, Kutas, & Sereno (1996)
- Present sentences that end either in words or pictures
  - *Why do you think they used this weird font?*
- Sentence completions in both modalities were sometimes congruous and sometimes incongruous?
  - *How does this manipulation help them distinguish between modality effects and congruity effects?*
- Blocked vs. Mixed Presentation
  - *Why do you think they varied this?*

Predicted Outcomes

Common Semantic System

- N400 congruity effects are exactly the same for words & pictures
- Differ only in onset and peak latency
  - Pictures have privileged access to the semantic system
- Differ only in amplitude
  - Information from different modalities accesses the semantic system in different ways, but ultimately it is the same system being accessed

Multiple Semantic Systems

- N400 congruity effect for words but not for pictures
  - Given previous findings, not likely!
- Similar morphology (waveshape) in words and pictures but different scalp distributions
  - Similar processing, but different brain areas participate
- Differ both in waveshape and scalp distribution
  - Totally different brain systems mediate word vs. picture semantics (as in Pavio's theory)

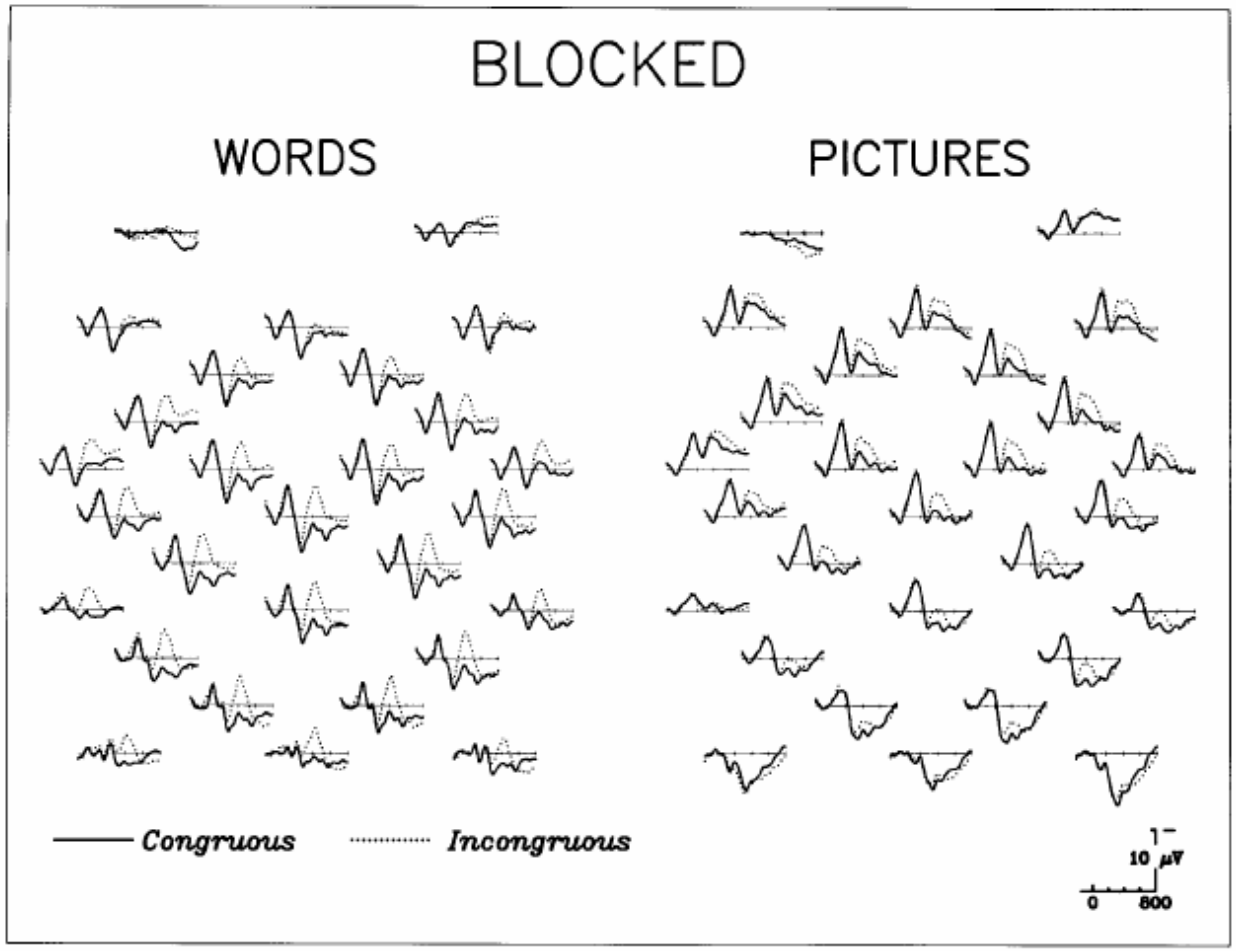


Figure 2. Grand average (N = 12) ERP waveforms obtained in the blocked condition for words (left) and pictures (right). Congruous endings are indicated by a solid line, while incongruous ones are indicated by a dotted line. The locations and labels of the electrodes are shown in the Method section, Figure 9. The topmost left and right plots in each panel show horizontal and below the eye data, respectively (see Method section for details). Note that in this and following plots, negative is up.

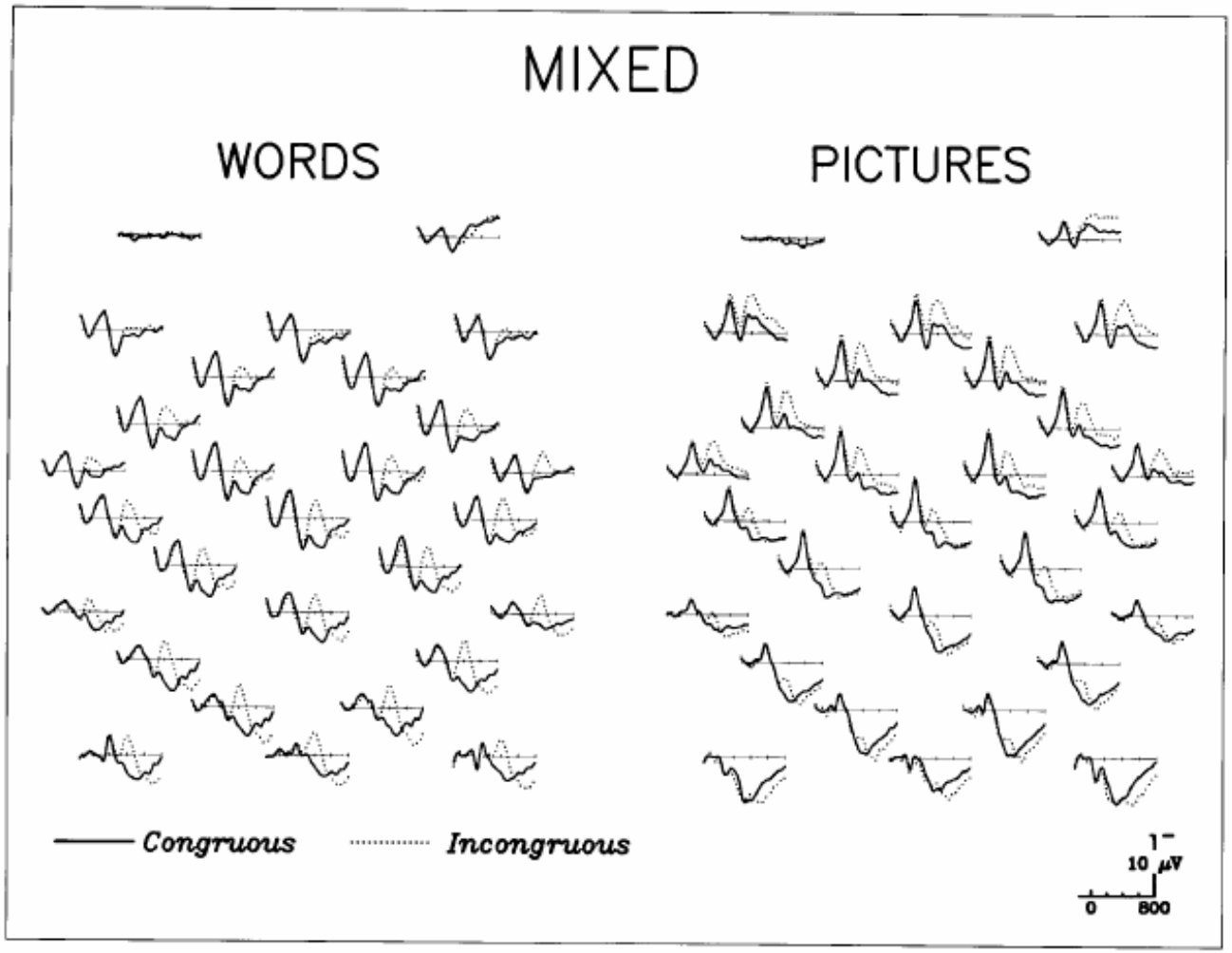


Figure 3. Grand average (N = 12) ERP waveforms obtained in the mixed condition for words (left) and pictures (right). Congruous endings are indicated by a solid line, while incongruous ones are indicated by a dotted line.

N400 Congruity Effects

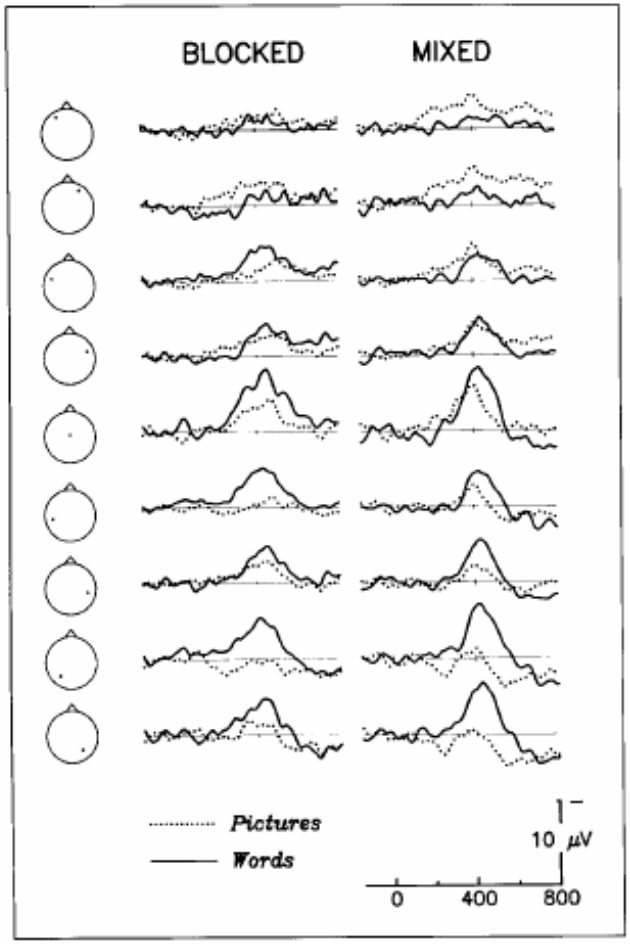


Figure 4. Difference ERP waveforms (incongruous minus congruous) obtained in the blocked (left) and mixed (right) conditions for words (solid line) and pictures (dotted lines). Only nine representative electrodes are shown for clarity.

- Amplitude
  - Larger for words than pictures
- Onset
  - In mixed (but not blocked) condition, N400 effect begins (30 ms) earlier in pictures
  - Suggest picture ERPs more variable in blocked condition
- Distribution
  - Frontal focus for pictures, posterior focus for words

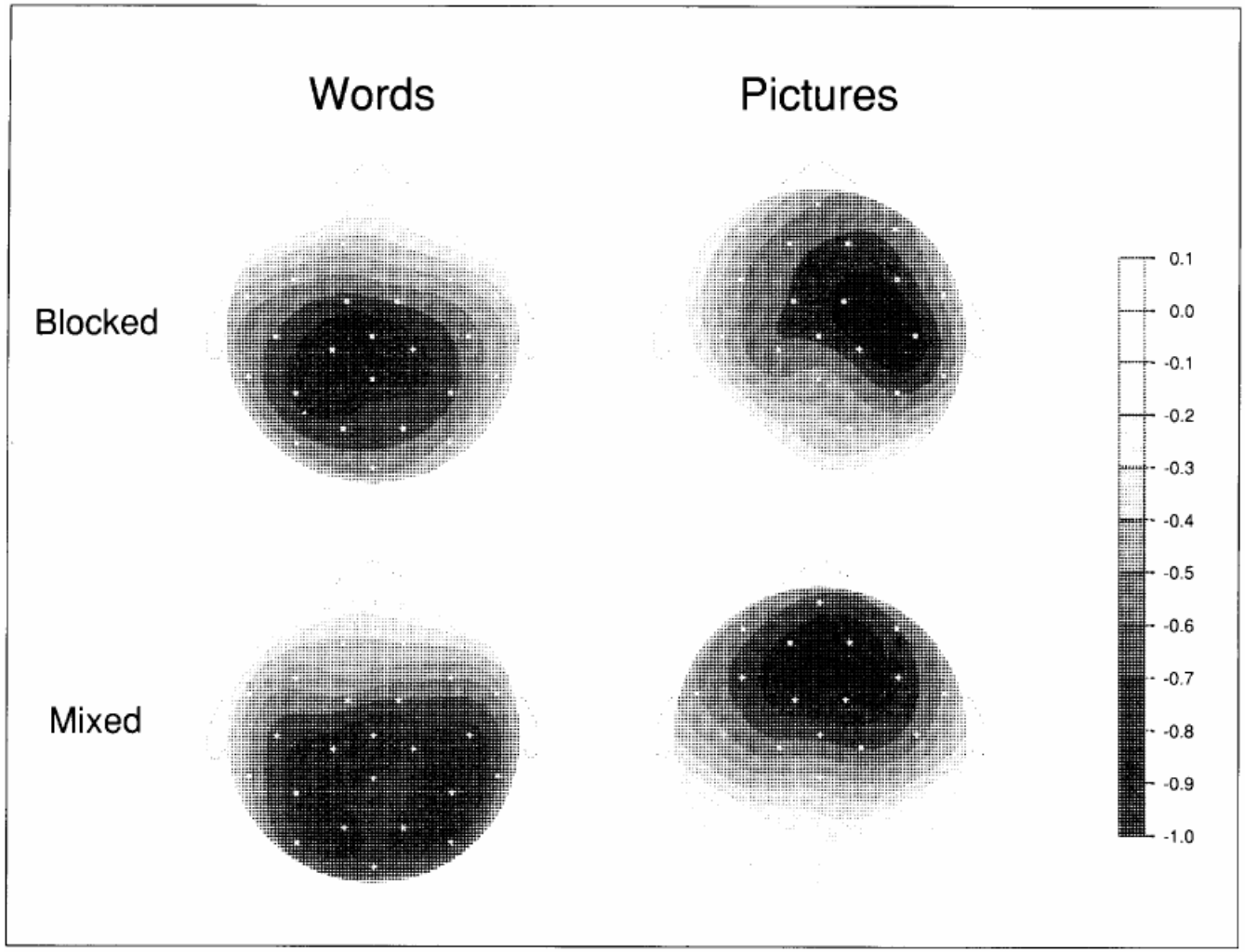


Figure 7. Isopotential gray-scale maps of the normalized distribution of the N400 effect (mean amplitude of the difference waves between 325 and 475 msec) in the blocked (top) and mixed (bottom) conditions for words (left) and pictures (right). The original scattered data (26 scalp sites) were interpolated with a spherical spline algorithm (Hassainia et al., 1994).

Late Positivity

- Words in Mixed condition
- Pictures in both Mixed & Blocked
  - Bigger for Mixed
- P300 elicited by different sorts of endings in Mixed condition
- Elicited by Pictures (even) in Blocked condition because of switch from words in sentence to picture
  - Pictures less probable overall than words in study

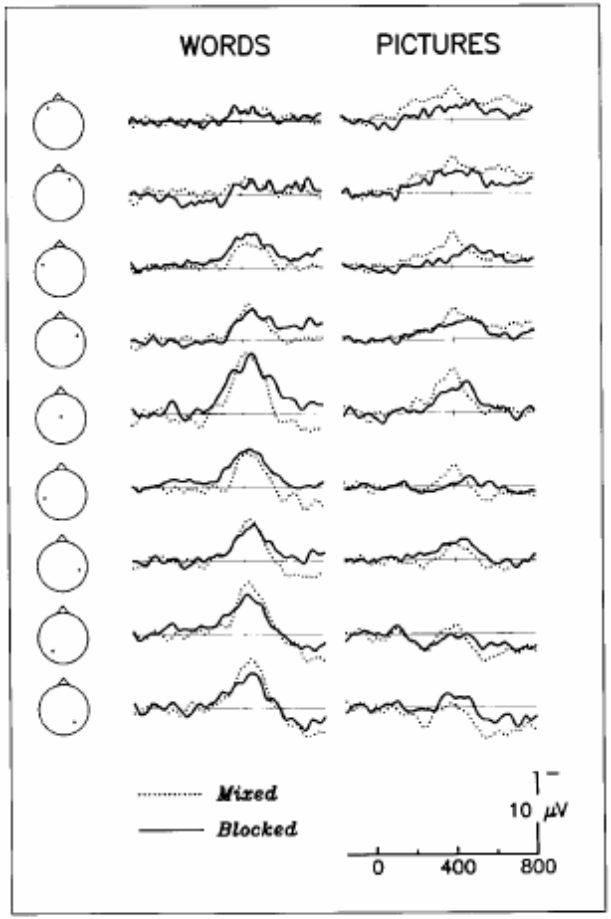


Figure 5. Difference ERP waveforms (incongruous minus congruous) obtained for words (left) and pictures (right) in the blocked (solid line) and mixed (dotted line) conditions.

Interpreting Distributional Differences

- “neural generators of the N400 to words and pictures actually do differ and this difference in the activated brain areas is manifest in the different scalp distributions.”
  - Multiple semantic systems
- N400 was the same in both conditions, but overlapping positivity makes the distributions appear different
  - Common semantic system w/modality-specific “noise”

Overlapping Positivity

- Positivity eliminates posterior N400 in pictures but not words because pictures elicit a positivity
- Reasons pictures might elicit a P3
  - Pictures less frequent than words
  - Pictures 1/8 of all stimuli in Blocked and 1/16 of all stimuli in Mixed
  - Greater P3 for pictures, and greater in Mixed than Blocked
- But, to eliminate (posterior) N400 in picture ERPs, P3 would have to be larger for incongruous than congruous
  - Relationship between N4 & P3 would have to be non-additive
- Kutas & Hillyard (1980)
  - I take my coffee with cream and sugar/SUGAR/dog/DOG
  - N400 for congruity
  - P560 for uppercase
  - Additive effects

- Overlapping positivity unlikely scenario

Interpreting Distributional Differences

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- N400 was the same in both conditions, but overlapping positivity makes the distributions appear different
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Picture N400

- Earlier onset of picture N400 (in Mixed) consistent with finding that people categorize pictures faster than they do words
- Frontal distribution may reflect generator in temporal pole

Different Contexts

- Previous study looked at ERPs to pictures being integrated into a linguistic context
- What about pictures in picture contexts?
- Addressed (among others) by Holcomb & McPherson (1994)
  - Record ERPs as people look at pairs of related vs. unrelated line drawings of objects

ERPs to pairs of line drawings

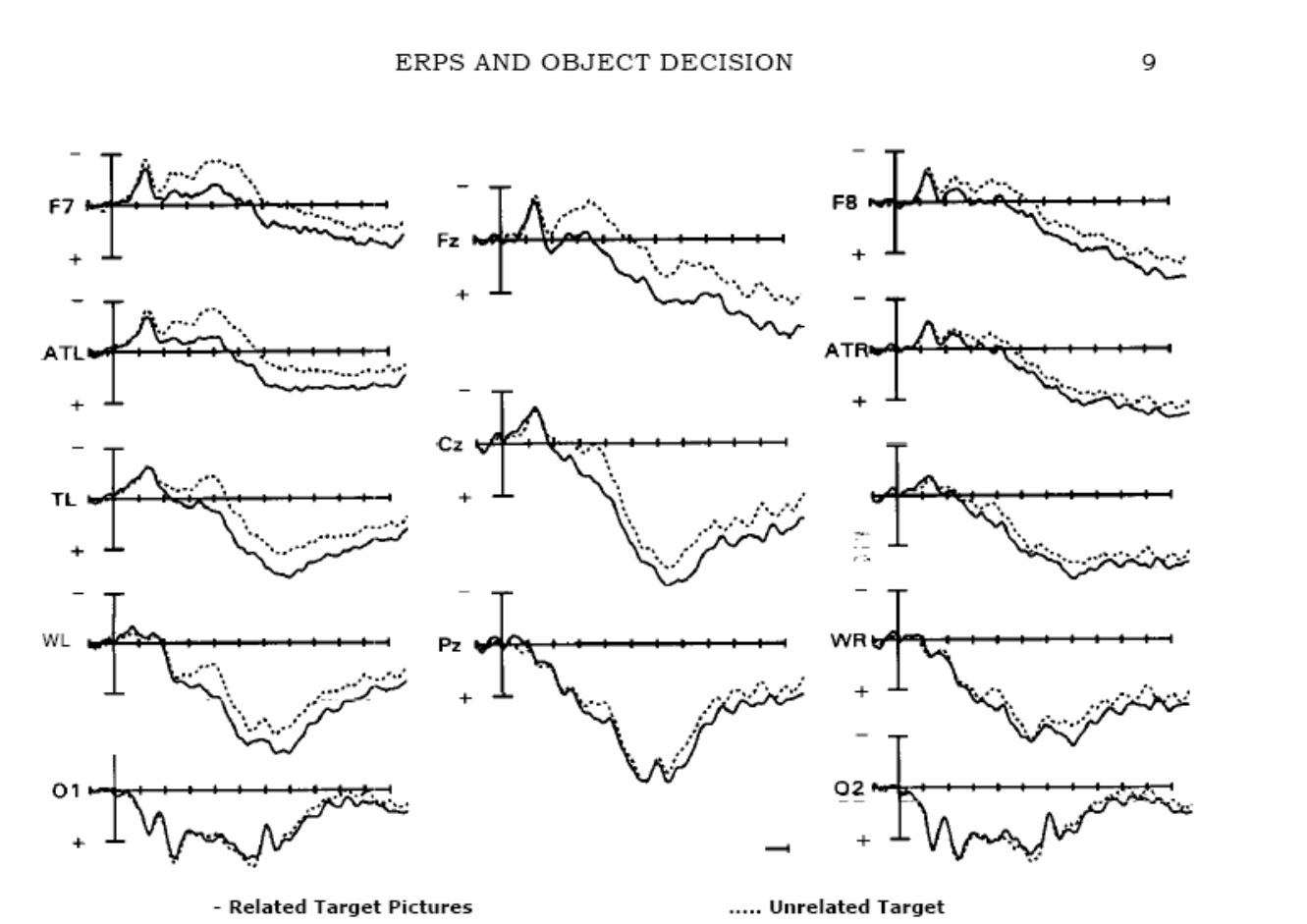
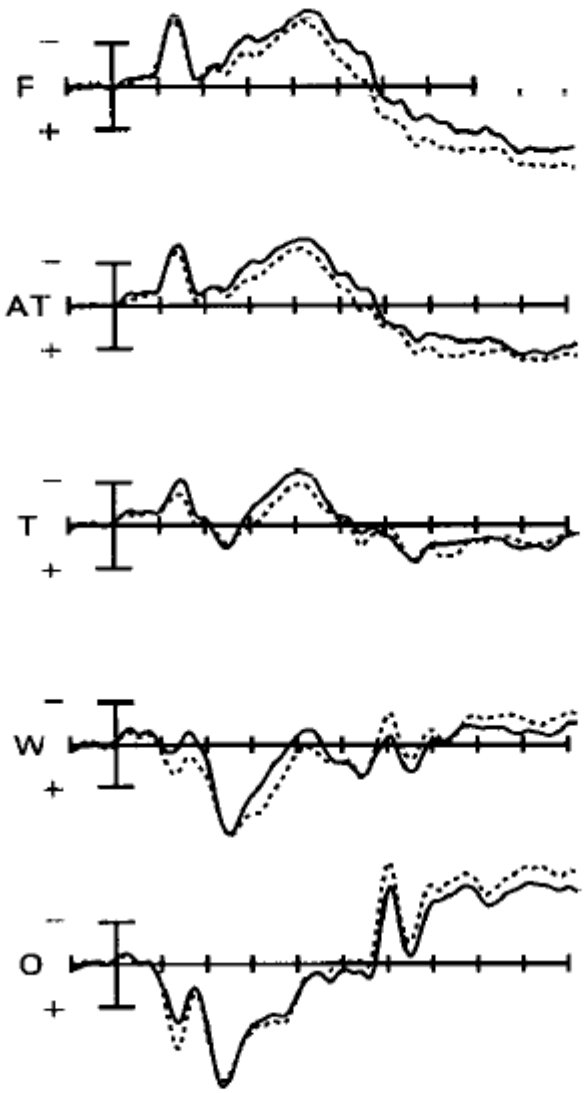


Fig. 1. Plotted in this figure are the grand average ERPS for the Related (solid) and Unrelated (dashed) target pictures. Stimulus onset is the vertical calibration bar (5 microvolts -negative up) and x-axis tics are in 100 msec. increments.

Holcomb & McPherson (1994)



Slight leftward asymmetry in picture N400 differs from slight rightward asymmetry in word N400

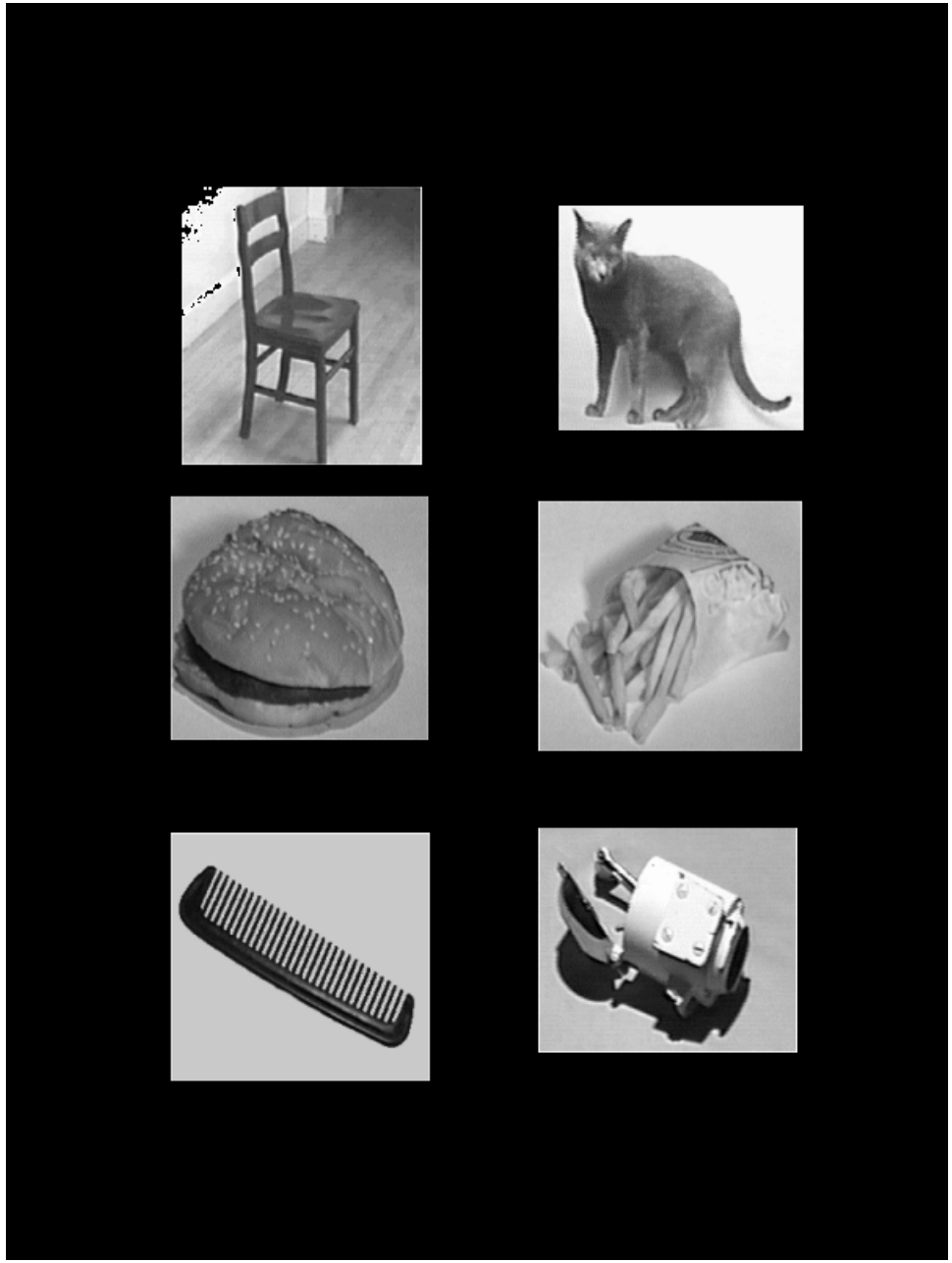
Supports multiple semantic systems

Holcomb & McPherson (1994)

FIG. 3. Plotted in this figure are the grand average ERPs for all the prime pictures. The left (solid) and right (dashed) hemispheres are overlapped. Stimulus onset is the vertical calibration bar which is 2 microvolts.

What about ERPs to photographs?

- Line drawings still representational (schematic)
- Photographs slightly closer to semantics activated by experience in the world
- McPherson & Holcomb (1998)
  - Related, Unrelated, and Unidentifiable Photos
  - Highly- vs. Moderately Related & Unrelated Photos



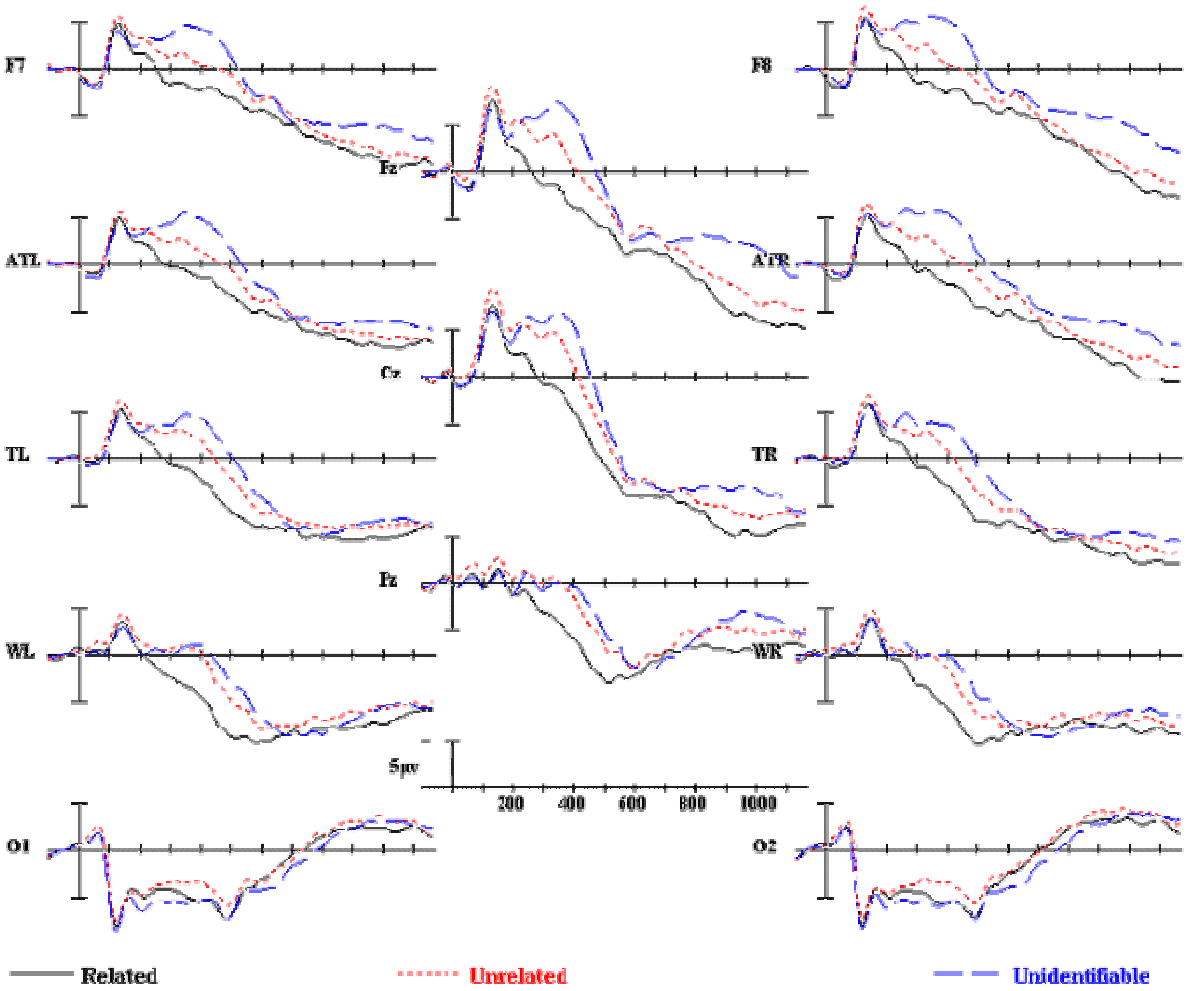
Unrelated

Related

Unidentifiable

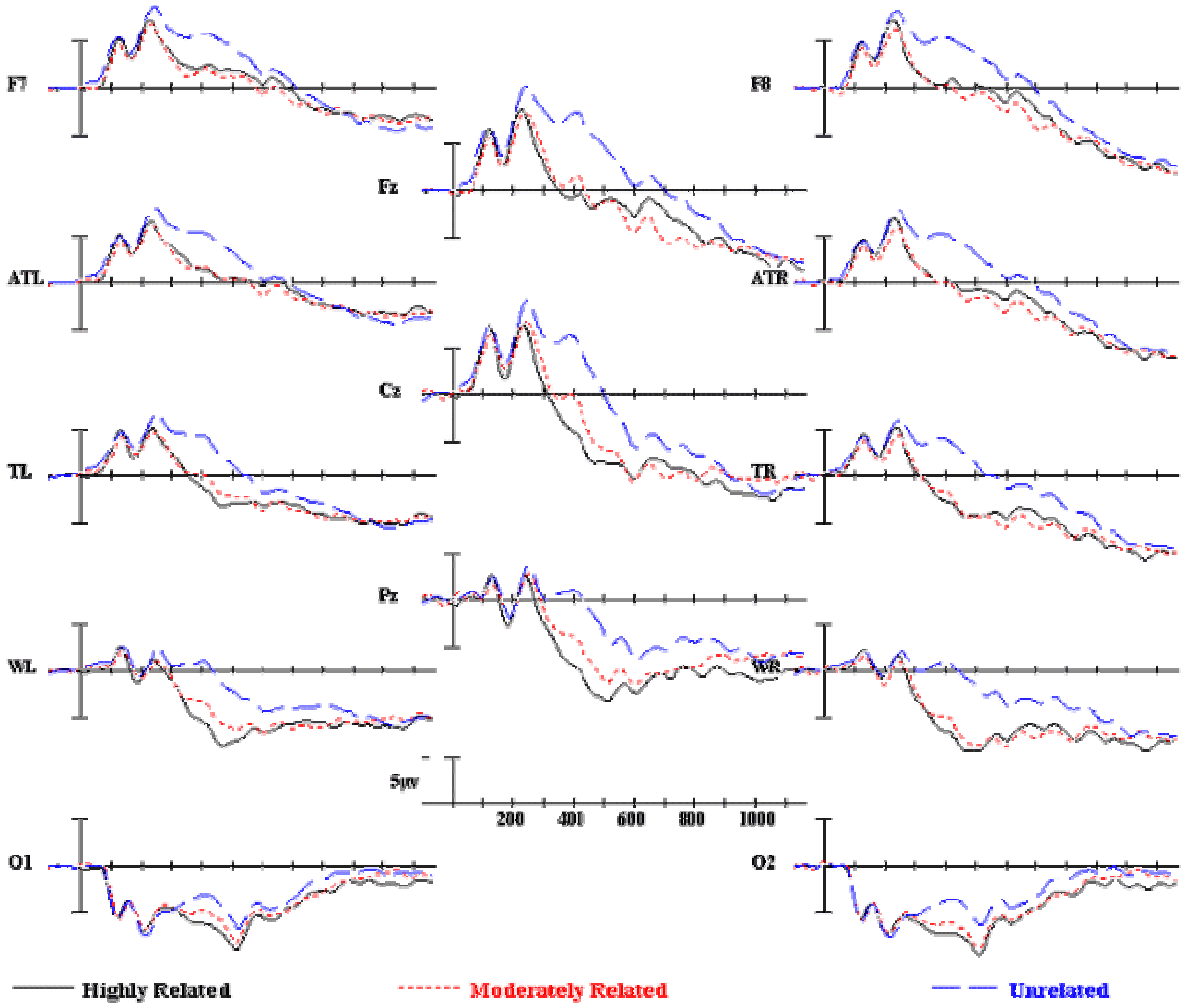
N300 & N400 both sensitive to identifiability & of visual objects

McPherson & Holcomb (1999)



Graded N400 but not N300 to relatedness scale

McPherson & Holcomb (1999)

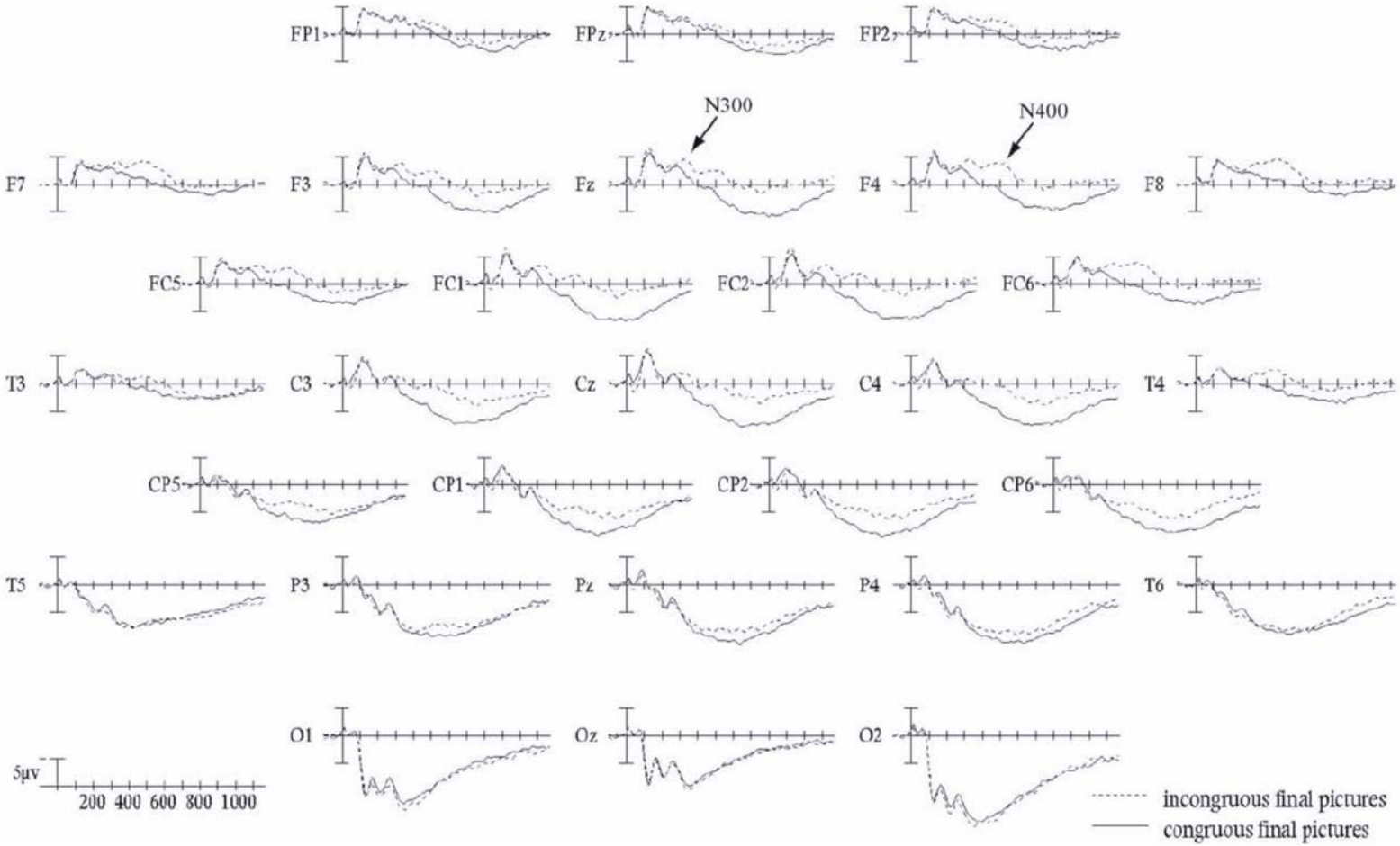


ERPs to pictures

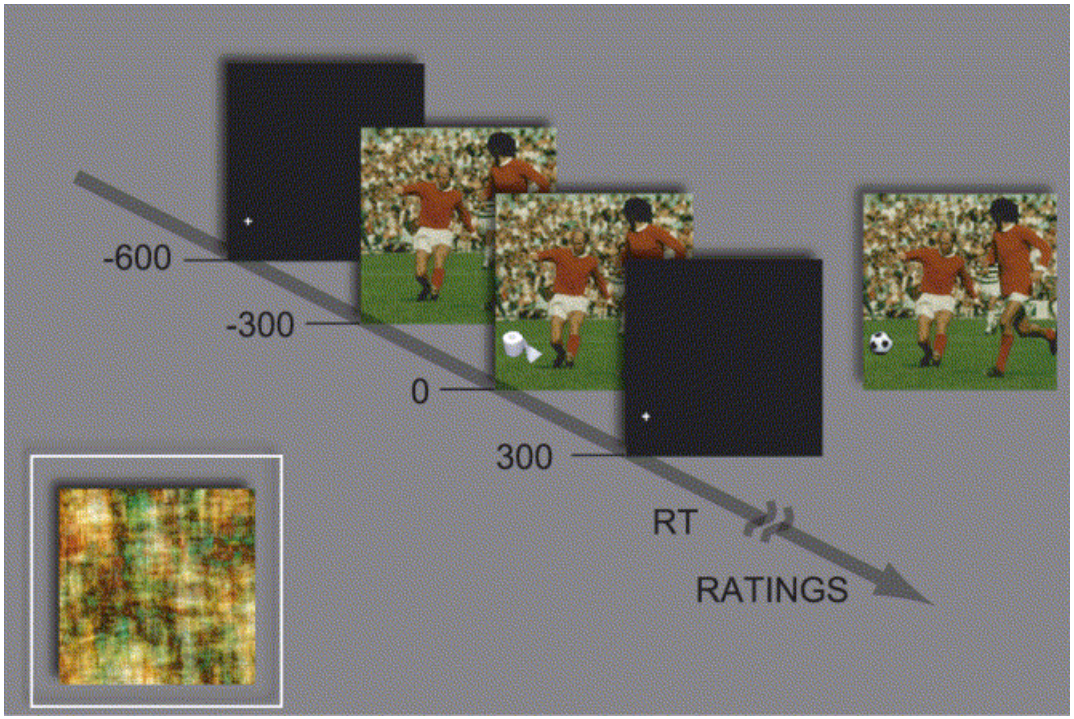
- N300
  - Anterior distribution
  - Picture-specific semantic system
- N400
  - Fronto-central distribution
  - More general semantic system

(West & Holcomb)

ERPs to Congruous and Incongruous Picture Completions



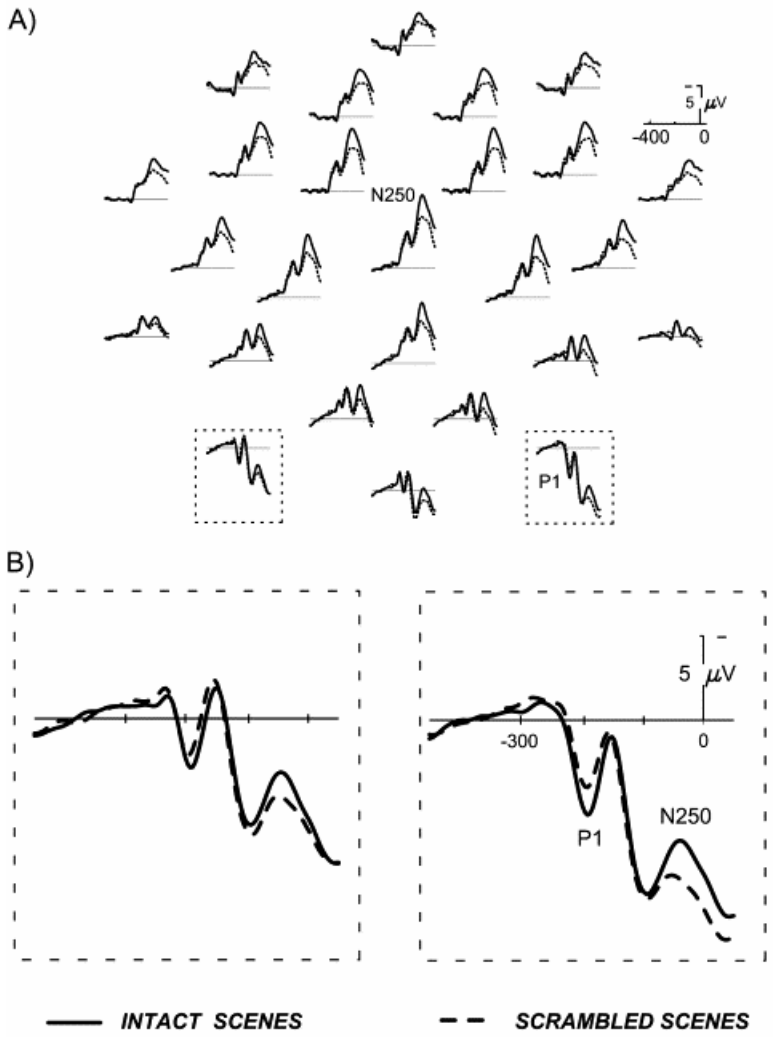
Objects in expected & unexpected locations



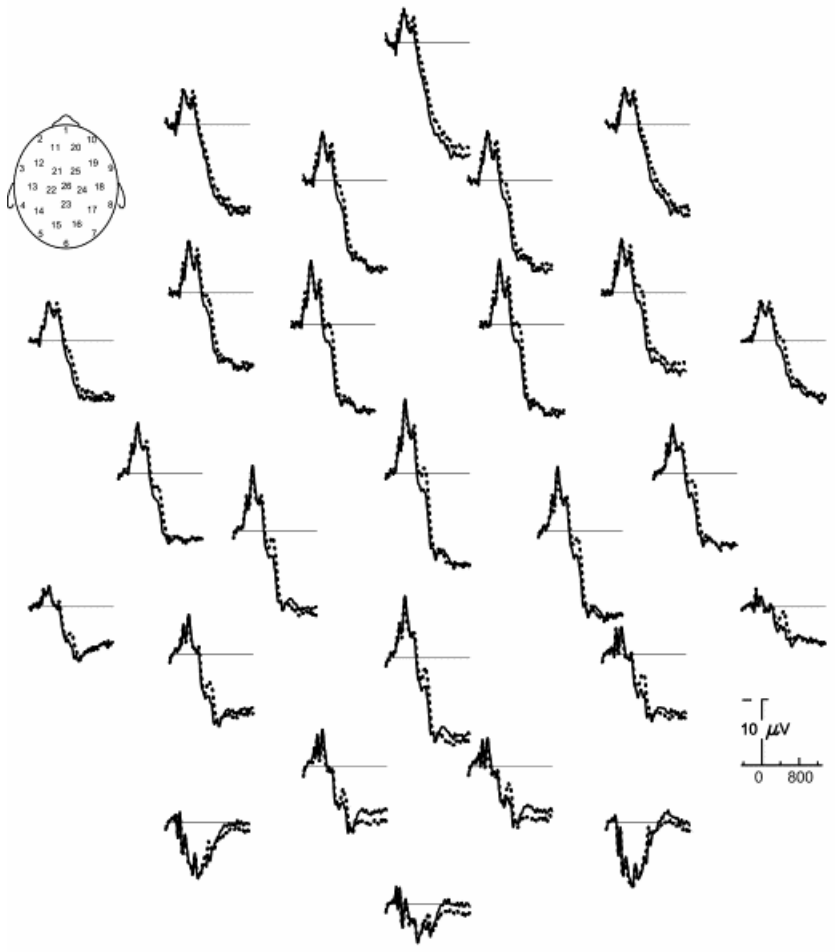
Ganis & Kutas, 2003

Intact vs. Scrambled Scenes

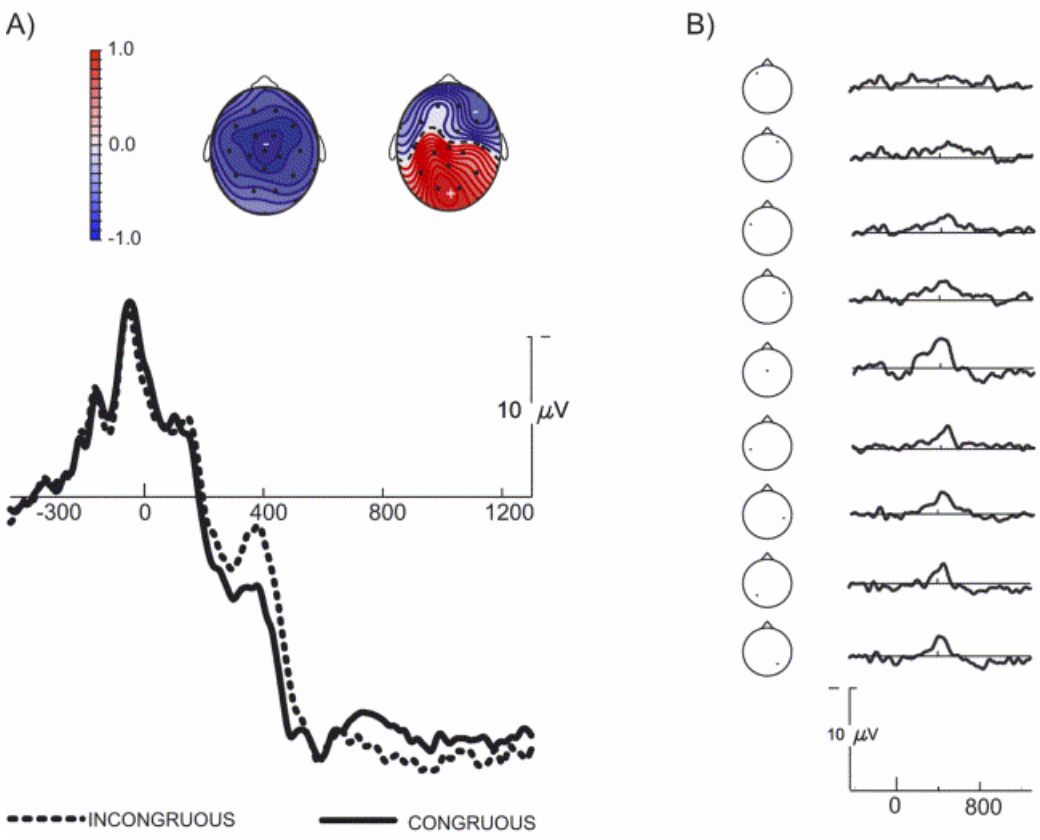
Ganis & Kutas, 2003



Congruous vs. Incongruous Objects



Ganis & Kutas, 2003

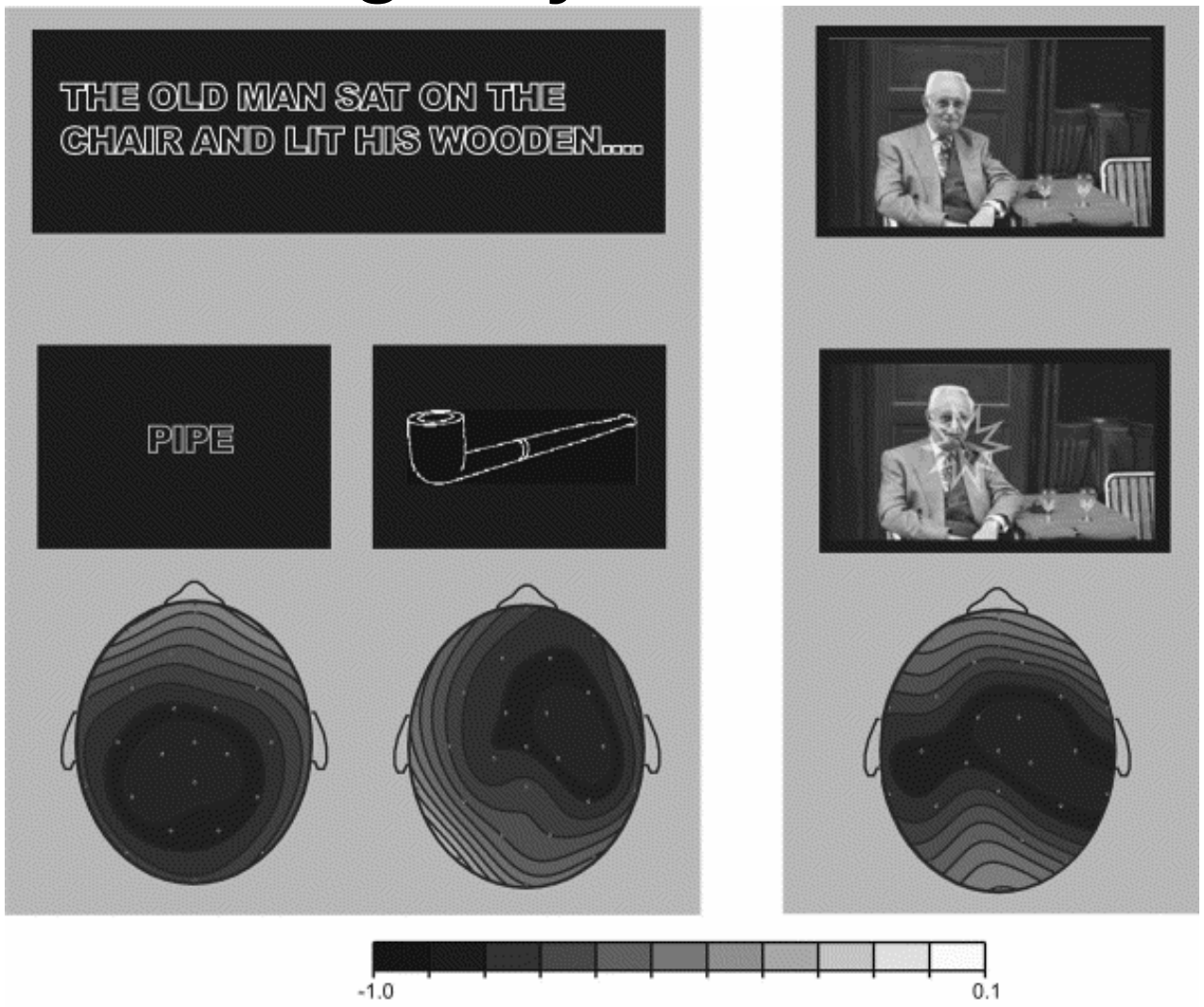


Ganis & Kutas, 2003

Congruity Effects

- Negativity: Picture N400
- No N300
  - Perhaps due to difficulty identifying objects in scenes
  - N300 context effects may only be detectable when simple visual stimuli presented in isolation
- Positivity: P300 elicited by unusual nature of the incongruous scenes

Scalp Distribution of Various Congruity Effects



Congruity Effects

- Ganis & Kutas argue that the 3 congruity effects similar but not identical
  - similar polarity, time course, and sensitivity to semantic context
  - somewhat different topographies (especially words)
- Multiple semantic systems w/important loci in anterior medial temporal lobe structures
  - Particular brain areas active in semantic processing depends on nature of context (linguistic or visual) as well as the stimulus (linguistic or imagistic)

Review Questions

- What is the main difference between the N400 elicited by words vs. pictures?
- What does this finding imply about the existence of a common semantic system?
- How does the scalp distribution of the N300 compare to that of the picture N400?
- What is the main evidence that N300 and N400 are different components?
- What has been proposed about the functional significance of the N300 vs. the N400?
- Should we be troubled by the fact that N300 congruity effects were not observed in the complex stimuli used by Ganis & Kutas (2003)?
  - If an effect is only observed in paradigms lacking ecological validity, do they reflect real brain processes?

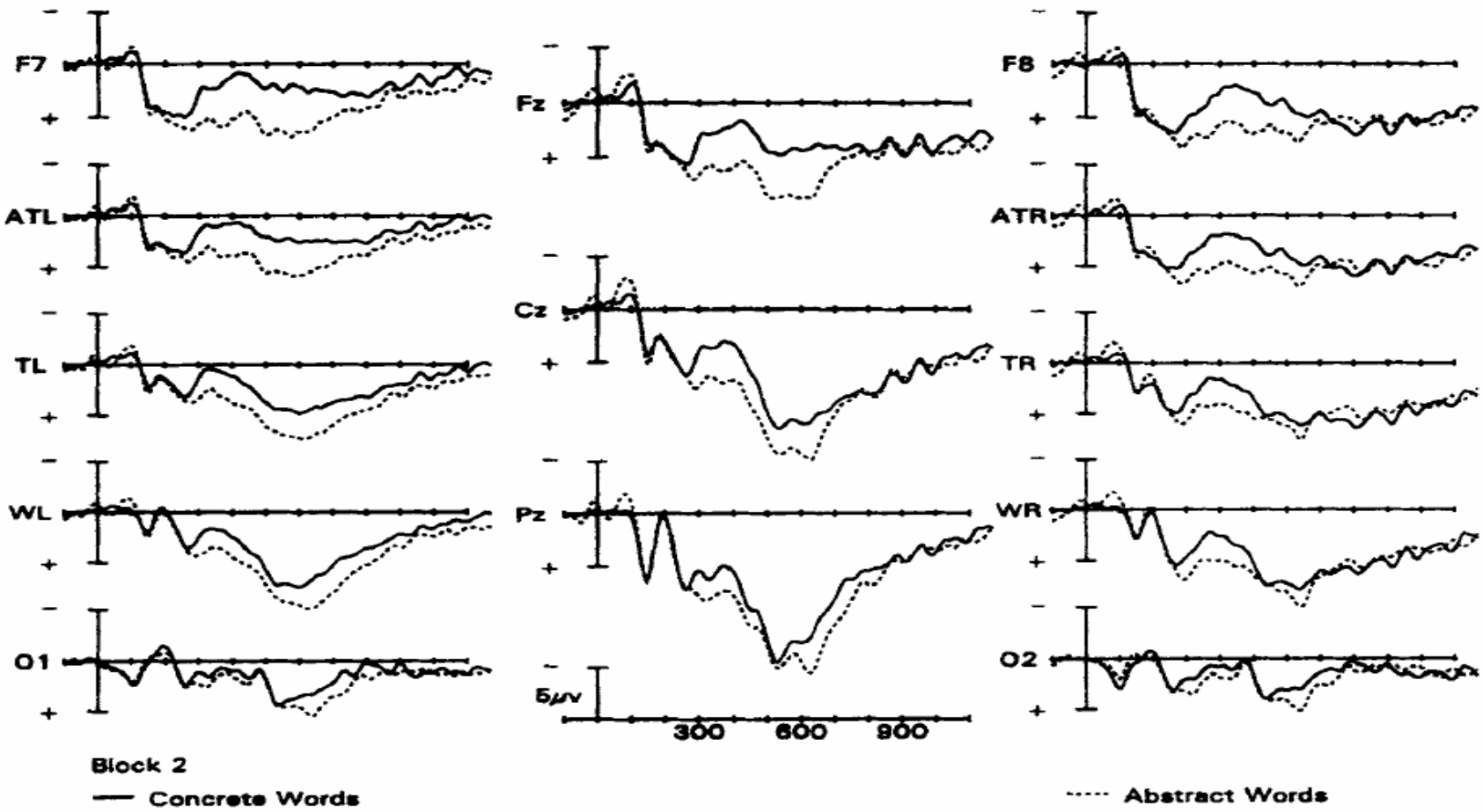
Concreteness Effects

- Concrete words understood more quickly and accurately
- Concrete words remembered better
  - Free recall
  - Cued recall

ERP Studies of Concreteness

- Kounios & Holcomb, 1994
  - Record ERPs as people do LDT on list of concrete words, abstract words & nonwords
  - Concrete Words elicit more N400 than Abstract Words
  - Anterior Distribution, R>L
  - Bears some similarity to picture N400
  - Dual Coding Theory

Kounios & Holcomb, 1994



Alternative Accounts of Concreteness Effects

Dual Coding

- Concreteness effects support multiple semantic systems proposals
- Concrete concepts easier to understand and more memorable because they are coded by both logogen and imagen systems

Context Availability

- Opponents have alternative interpretation of concreteness effects
- Ease of comprehension a function of contextual support
  - Concrete concepts are associated with lots of perceptual features, so come with their own context
  - Abstract concepts do not, so rely more on surrounding context
- Predicts that if contextual support equated, concreteness effects go away
- Behavioral tests confirm this prediction of context availability

Concreteness and Context:ERPs

- Holcomb et al., 1999
  - Used congruous, anomalous, and neutral sentence contexts
- Concrete & Congruent
  - Armed robbery implies that the thief used a *weapon*.
- Abstract & Congruent
  - Lisa argued that this had not been the case in one single *instance*.
- Concrete & Anomalous
  - Armed robbery implies that the thief used a *rose*.
- Abstract & Anomalous
  - Lisa argued that this had not been the case in one single *fun*.
- Concrete & Neutral
  - They said it was because of the *rose*.
  - Robert said it was due to the *weapon*.
- Abstract & Neutral
  - They said it was because of the *fun*.
  - Robert said it was due to this *instance*.

Concreteness effects found in neutral sentences

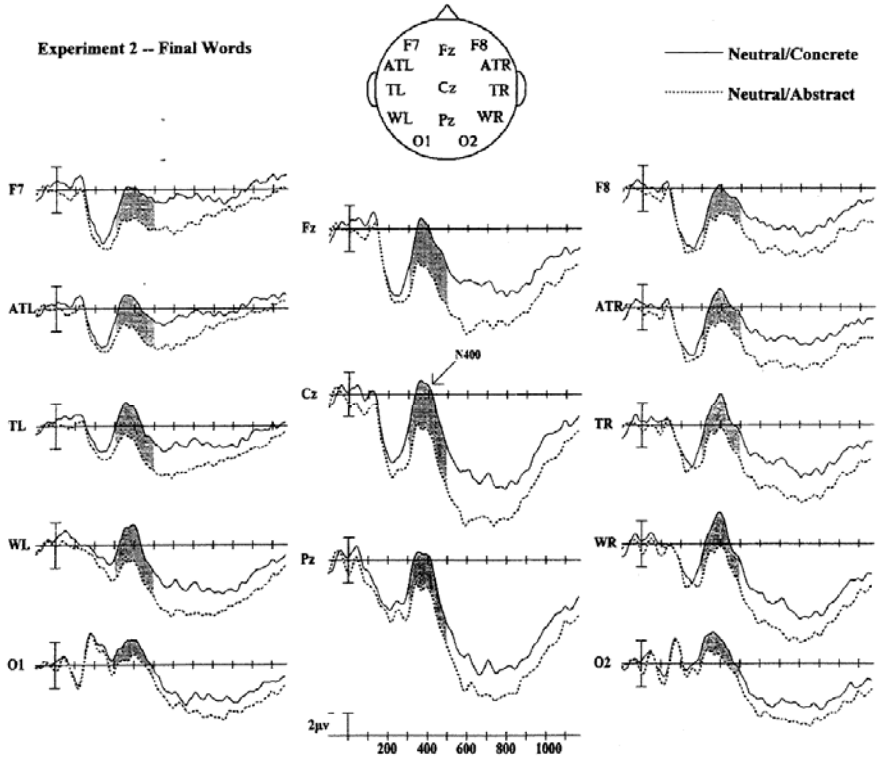


Figure 8. Grand mean event-related potentials for neutral final words that were concrete or abstract (Experiment 2).

Holcomb et al., 1999

They said it was because of the **rose**/*fun*.

Robert said it was due to this **weapon**/*instance*.

Concreteness effects found in anomalous sentences

Holcomb et al., 1999

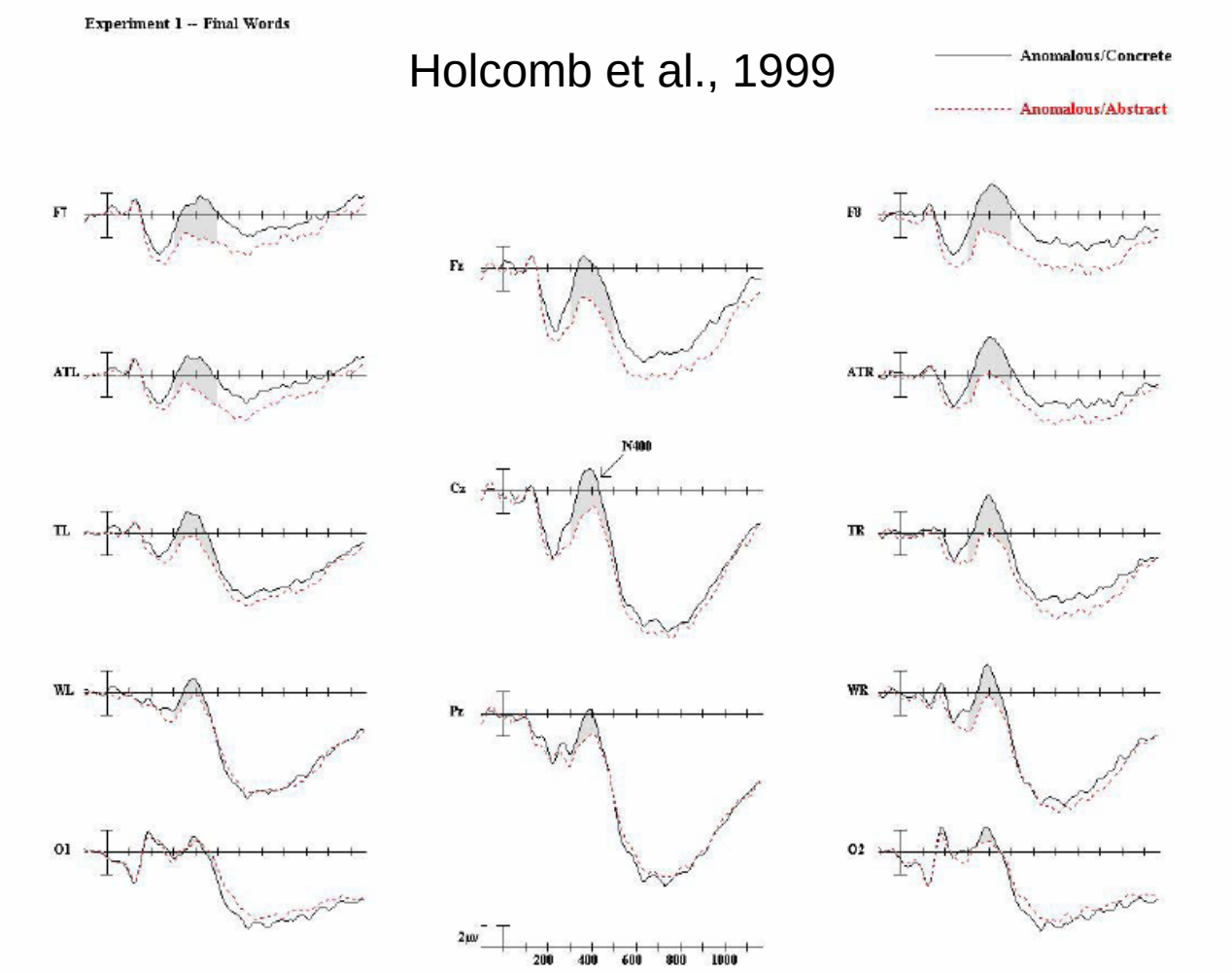


Figure 4. Grand mean ERPs for anomalous final words that were concrete or abstract (Experiment 1).

Concreteness effects ***not*** present in congruent sentences

Holcomb et al., 1999

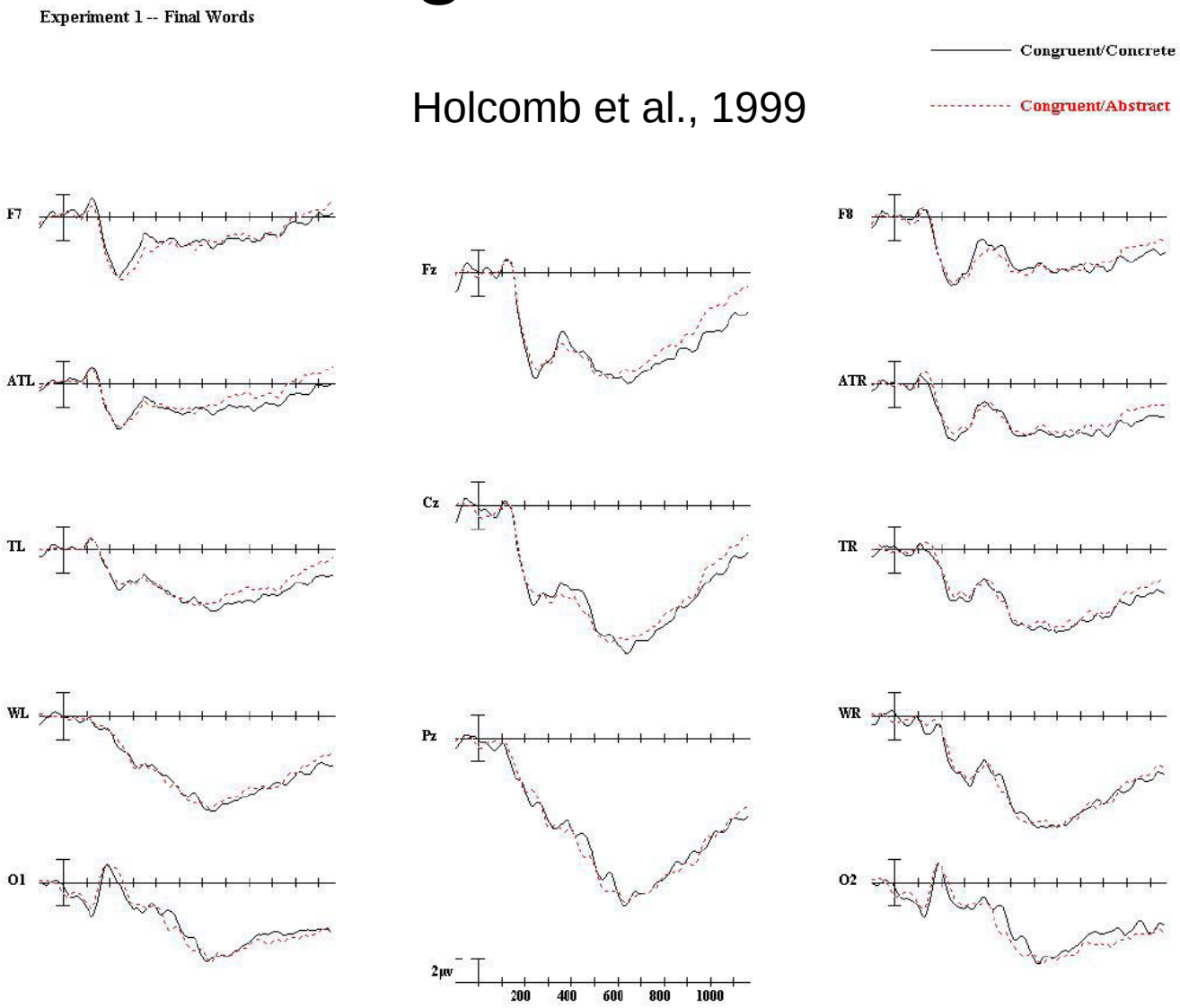


Figure 3. Grand mean ERPs for congruent final words that were concrete or abstract (Experiment 1).

But, context affects concrete words more than abstract words

Holcomb et al., 1999

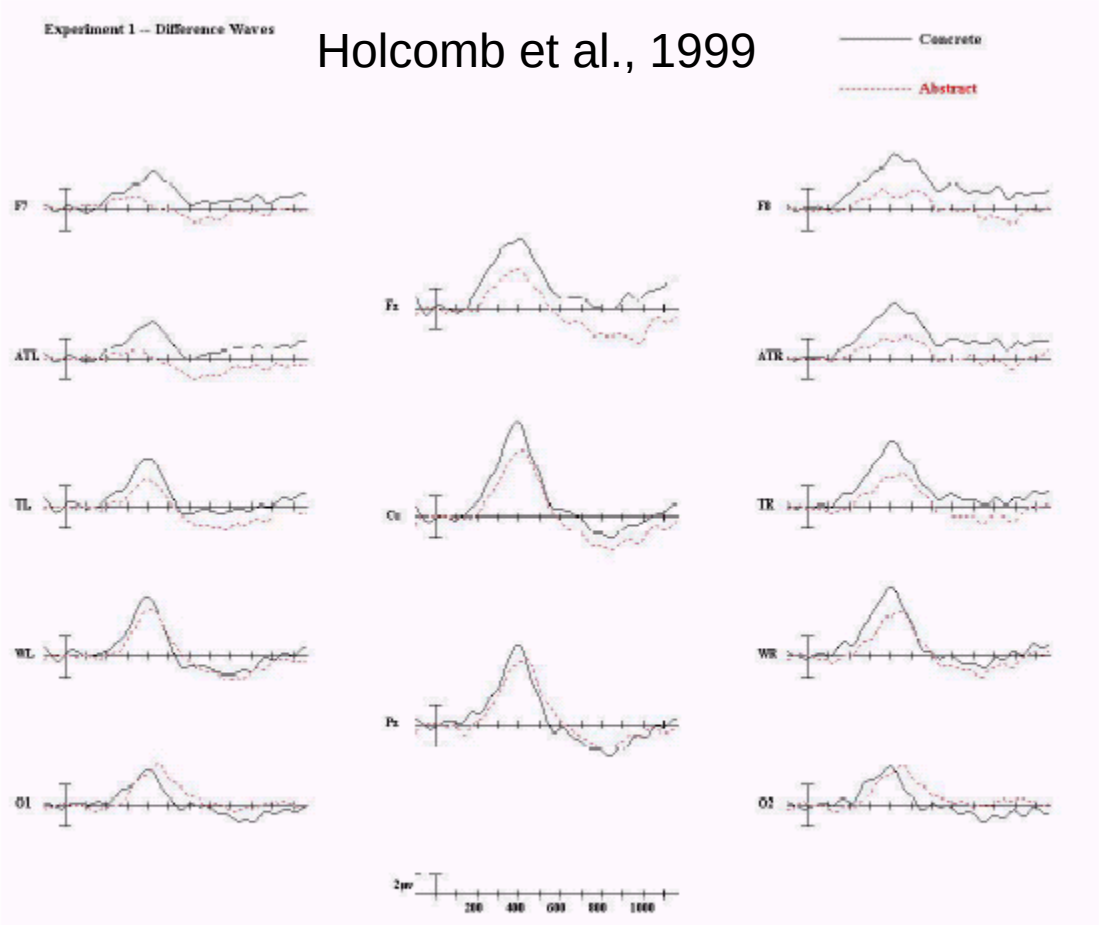


Figure 2. Plotted in this figure are difference waves which were produced by subtracting ERPs to congruent sentences from ERPs to anomalous sentences, for concrete and abstract final words in Experiment 1. The area under the large negative deflection between 200 and 600 ms represents the N400 effect (the difference between the anomalous and congruent final words). Note that this effect is larger for concrete and abstract words, especially at the most anterior sites.

Concreteness x Context Interactions

- The elimination of concreteness effects in supportive sentence contexts is consistent with predictions of context availability (and common semantic system)
- Context availability is idea that abstract words rely more on context than concrete words
  - If so, why is it that ERPs to concrete words show larger context effects than abstract words
  - If only one semantic system, why are ERPs to concrete words anteriorly distributed in the anomalous and neutral condition, but posteriorly distributed (like abstract words) in the congruent condition?
- Holcomb argues for dual semantic systems
  - Minimal contexts: use of *both* systems for concrete words & logogen system for abstract words
  - Supportive sentence contexts: concrete words only utilize logogen system, as do abstract words

Minimal Contexts

- To better dissociate context and concreteness effects, Swaab et al. (2002) used minimal contexts
- They used both high and low imageable words in related and unrelated contexts to see if they could dissociate the concreteness and context effects

Table 1
Examples of related and unrelated word pairs in the low and the high imageability conditions. Related word pairs were either associates or from the same semantic category

	Low imageable	High imageable
Related	Atom–molecule	Bread–butter
	Month–minute	Pig–leopard
Unrelated	Pace–dispute	Wheat–slipper
	Bile–sentence	Yacht–balloon

Results

- ERPs to high imageable words more negative than low imageable words
- ERPs to related words more negative than unrelated words
- Two effects were additive
  - Suggests independent generators

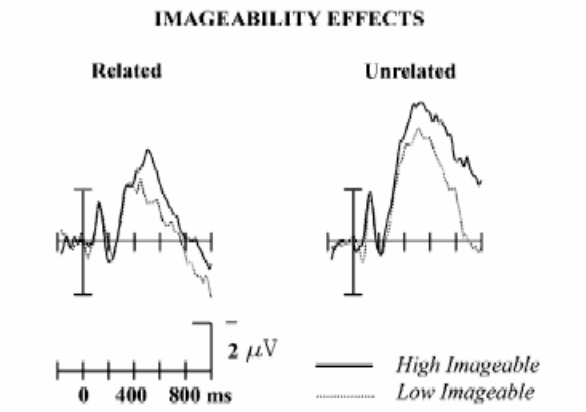


Fig. 2. Imageability effects (high imageable vs. low imageable) for the related and unrelated context conditions for electrode F4 (right frontal).

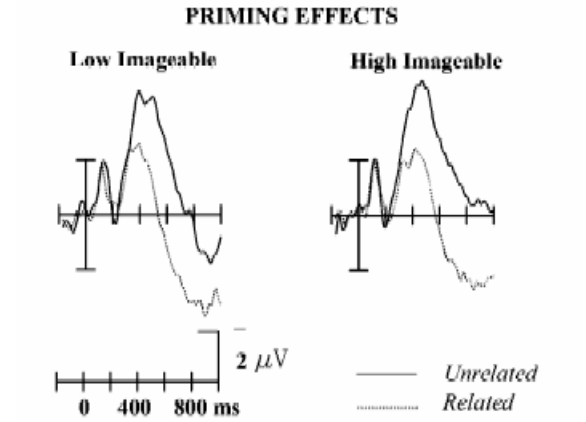


Fig. 3. N400 priming effect (unrelated vs. related) for the high and the low imageable target words for electrode Pz (midline posterior).

Swaab et al., (2002)

Scalp Distribution

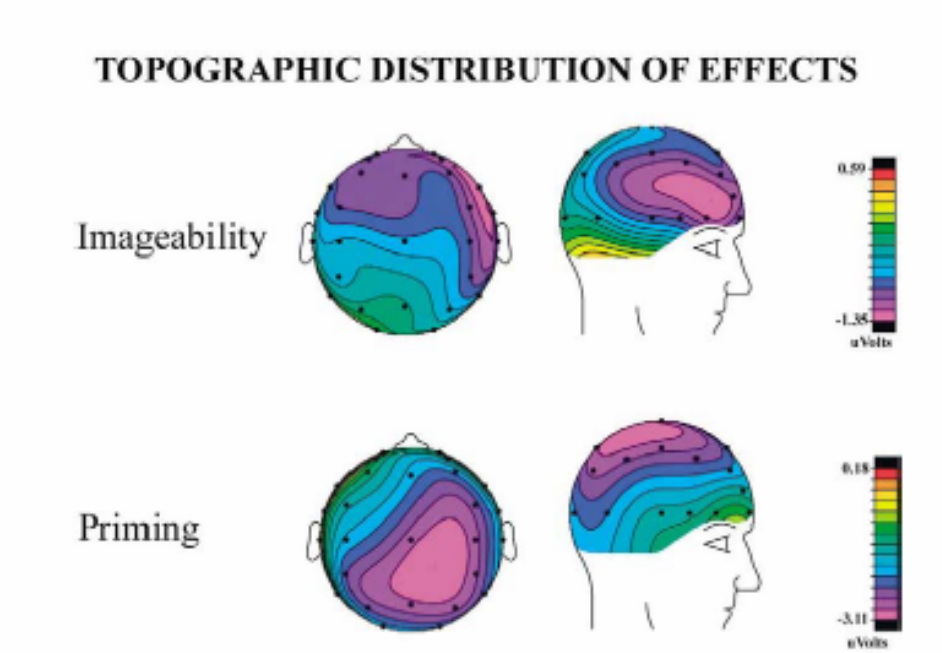


Fig. 1. Topographic distribution of the ERP effects. Pink colors indicate the negative maximum of the effects. The top part of this picture shows a frontal maximum for the ERP imageability effect (high imageable–low imageable). The bottom part shows the posterior maximum for the ERP priming effect (unrelated–related; i.e. the N400).

Swaab et al., (2002)

Review Questions

- How do ERPs to concrete words differ from those to abstract words during the interval the N400 is measured in?
- Does this support proposals for common or multiple semantic systems?
- Concreteness effects are evident in ERPs to words in neutral sentences
  - Are they also seen in anomalous sentence completions?
  - Are they seen in congruous sentence completions?
- Concreteness effects go away in supportive sentence contexts
  - How is this finding explained by dual coding theory?
  - How is this finding explained by context availability theory?
- Describe an ERP finding that argues against the explanation based on context availability theory